DESIGN OF WIRELESS WEATHER MONITORING SYSTEM

Thesis submitted in partial fulfilment of the requirements for the degree

of

Bachelor of Technology

in

Electronics and Communication Engineering

by

KESHAV KUMAR SINGH
ROLL NO: 109EC0242
and
S.STYLINE CHIRMAXO
ROLL NO: 109EC0217

Department of Electronics & Communication Engineering

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Under the guidance of

Prof. S.Hiremath

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CERTIFICATE

This is to certify that the thesis entitled, "**DESIGIN OF WIRELESS WEATHER MONITORING SYSTEM**" submitted by **Keshav Kumar Singh(109ec0242)** and **S.Styline Chirmaxo(109ec0217)** in partial fulfilment of the requirements for the award of **Bachelor Of Technology** degree in **Electronics and Communication Engineering** during session 2009-2013 at National Institute of Technology, Rourkela (Deemed University) is an authentic work carried out by them under my supervision and guidance.

To the best of my knowledge, the matter embodied in the thesis has not been submitted to any other university/institute for the award of any Degree or Diploma.

Date:13th MAY,2013

Prof. S. Hiremath

Dept. Of Electronics and Communication Engineering

National Institute of Technology Rourkela

Email: hiremaths@nitrkl.ac.in

Acknowledgment

We would like to express our gratitude to our guide Prof. S. Hiremath for his patience, immense knowledge , motivation and constant support. His guidance has helped us throughout our project work and in writing our thesis at NIT, Rourkela.

Besides our guide, we would like to thank Prof. S.K. Patra, Prof. K. K. Mahapatra, Prof. Poonam Singh, Prof. S.K. Das, Prof. A. K Sahoo, Prof. Samit Ari, Prof. S.K. Behera, Prof. D. P. Acharya and Prof. A.K. Swain for their encouragement and insightful comments.

We would like to thank all faculty members and staff of the Department of Electronics and Communication Engineering, N.I.T. Rourkela for their generous help in various ways for the completion of this thesis.

We would like to thank all our friends and especially our classmates for all the discussions .We've enjoyed their companionship during our stay at NIT, Rourkela.

We are especially indebted to our parents for their love, sacrifice, and support. Our full dedication to the work would have not been possible without their blessings and moral support. This thesis is a dedication to them.

Keshav Kumar Singh
Roll No: 109ec0242

S.Styline Chirmaxo
Roll No: 109ec0217

Department of Electronics and Communication Engineering,
National Institute of Technology, Rourkela
Rourkela-769008

ABSTRACT

The main objective of this project is to devise a simple low cost microcontroller based weather monitoring system using wireless technology which fetches weather conditions using various sensors like temp, humidity… etc , displays it on LCD and forwards it to remote user by SMS.This project is developed by using ATMEGA-32 Microcontroller, SIM 300 GSM Module, LCD display and LM35 temperature sensor.

The advantage of using GSM based technology is that GSM based communication network is widespread and have almost reached to every nook and corners of this 21st century world. GSM technology also do provide users with high quality signal and channels, giving them access to high quality digital communication at very affordable rates.

This embedded system can prove to be useful for anyone who wish to monitor the weather condition of a location without being physically present there.

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ACRONYMS

LCD – Liquid Crystal Display

USART – Universal Synchronous Asynchronous Receiver/Transmitter

MCU-Microcontroller Unit

ADC-Analog to digital conversion

ATmega32- Atmel 8-bit AVR RISC based microcontroller

RISC- Reduced instruction set computing

GSM– Global System for Mobile Communications

CMOS- Complementary metal–oxide–semiconductor

MIPS- Million instructions per second

PCB – Printed Circuit Board

Chapter 1

Introduction

1.1 Introduction

In this 21st century, weather monitoring holds great importance and have uses in several areas ranging from keeping track of agricultural field weather conditions to industrial conditions monitoring. Weather monitoring would help in keeping track of different climatic behaviors including temperature, humidity and light intensity. Weather Monitoring System can be either wired or wireless one. In case of wireless communication, the connectivity will be more convenient and user friendly and weather monitoring would not require physical presence of the person at the location[1]. Wireless communication is the transfer of information over a distance without the use of wires. The distances involved may be short (a few meters as in television remote control) or long (thousands or millions of kilometers for radio communications).GSM technology is the cheapest and the most convenient technology now being used for wireless communication. The wireless weather monitoring system basically requires few basic modules such as GSM module, display module, sensors and microcontroller module[2].

1.2 Motivation

The primary motivation behind taking up this project is the large utility of the wireless weather monitoring in varied areas ranging from agricultural growth and development to industrial development. The weather conditions of a field can be monitored from a distant place by farmers and won't require them to be physically present there in order to know the climatic behavior at the location by using wireless communication. It will be of great use in the war affected regions as it would be risky for farmers to visit their farm regularly, instead now they could monitor their farm from their home[1].

1.3 Objective

The objective of this project is to design a wireless weather monitoring system in which a microcontroller is interfaced with sensors, LCD and GSM module to transmit sensed data wirelessly.

- Analog data from LM35 is to be fetched and fed to one of the ADC channel of Microcontroller.
- Display the temperature on LCD screen which is pre-processed and calculated by ATmega32.
- Send the measured temperature to user with the help of GSM module(SIM 300) Via SMS.

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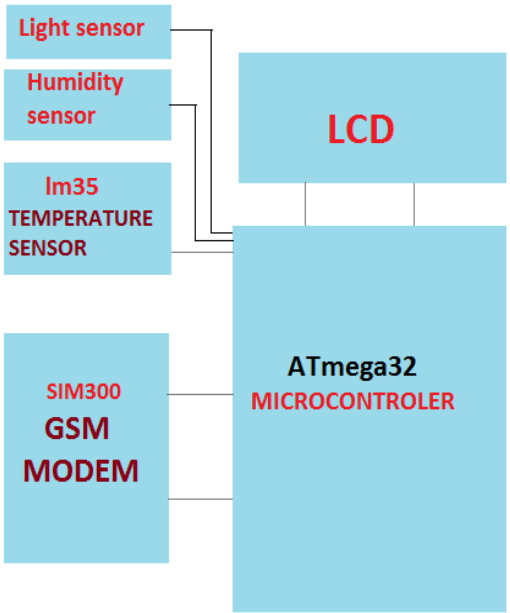

Figure 1.1 Block diagram of proposed model

1.4 Thesis overview

The overview of the thesis is as follows:

Chapter 2- Overview of the devices being used: It gives brief idea about the sensor, LCD display, GSM module and the microcontroller being used.It also describes about the software module being used.

Chapter 3- System Design: It explains about architecture and interfacing of the devices used.

Chapter4- Results and discussion: Describes the results and output of the system.

Chapter 5-Conclusions and Future Scope: It gives the conclusions drawn from the paper and brief ideas about future development works that can be undertaken.

Chapter 2

Overview of the Devices Used

2.1 LM35

The LM35 series are precision integrated-circuit temperature sensors. Its output voltage is linearly proportional to the Celsius temperature for a large range of temperature values. The LM35 thus has an upper hand over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. The LM35 need not use any external calibration or trimming to provide usual accuracies of ±1⁄4°C at room(moderate) temperature and ±3⁄4°C over a full −55 to +150°C temperature range[5].

2.1.1 Features of LM35

- Calibrated directly in ° Celsius (Centigrade)
- Linear + 10.0 mV/°C scale factor
- 0.5°C accuracy guarantee (at +25°C)
- Rated for full −55° to +150°C range
- Suitable for remote applications
- Low cost due to wafer-level trimming
- Operates from 4 to 30 volts
- Less than 60 μA current drain
- Low self-heating, 0.08°C in still air
- Nonlinearity only ±1⁄4°C typical
- Low impedance output, 0.1 W for 1 mA load[5]

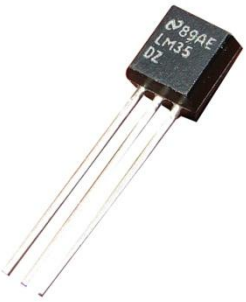

Fig2.1: plastic package LM35 DZ

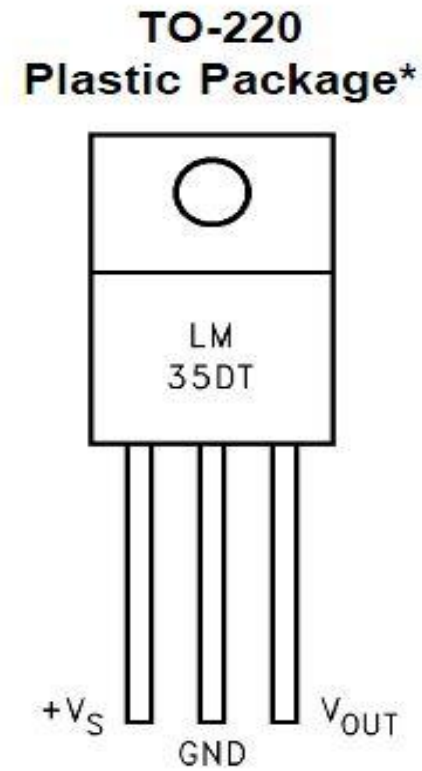

Fig 2.2:pin layout

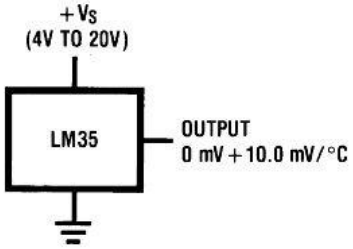

Fig 2.3 voltage outputs

2.2 LCD JHD162A

A liquid-crystal display is a flat panel, electronic visual display that uses the light modulating properties of liquid crystals. Liquid crystal does not emit light directly. The working of LCD depend on two sheets of polarizing material with a liquid crystal solution in between them. When an electric current is passed through the liquid, it causes the crystals to align so that it blocks out light and does not allow it to pass[10]. Each crystal behaves like a shutter, it either allows light to pass through or blocks the light.

It can function properly in the temperature range of -10℃ to 60℃ and has operating lifetime of longer than 50000 hours (at room temperature without direct irradiation of sunlight).

2.2.1 Features of LCD JHD162A

- Display Mode……TN/STN
- Number of data line……8-bit parallel
- Display type…… ..Positive Transflective
- Backlight……LED(B/5.0V)
- Viewing direction……..6 o'clock
- Operating Temperature……...Indoor
- Driving Voltage……. Single power
- Type……...COB (Chip On Board)
- Connector…… …..Pin
- Driving method……..1/16 duty,1/5 bias
- Display construction……..16 Characters * 2 Lines [8]

Fig 2.4 LCDJHD 162A

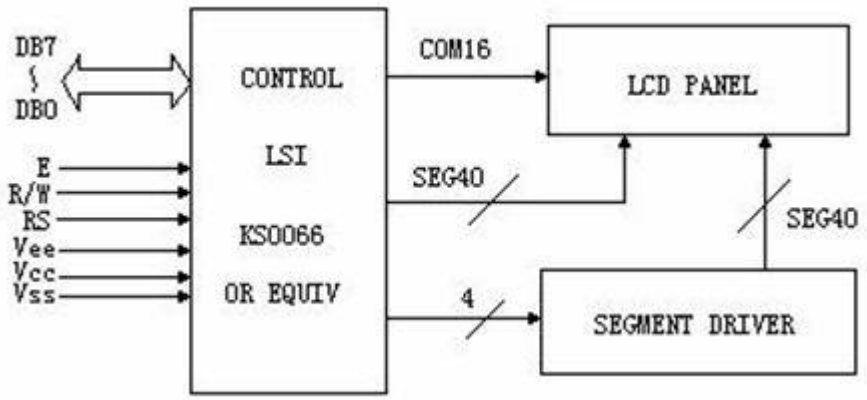

Fig 2.5: LCD Block Diagram

PIN NO.	SYMBOL	DESCRIPTION	FUNCTION
1	VSS	GROUND	0V (GND)
2	VCC	POWER SUPPLY FOR LOGIC CIRCUIT	+5V
3	VEE	LCD CONTRAST ADJUSTMENT	
4	RS	INSTRUCTION/DATA REGISTER SELECTION	RS = 0 : INSTRUCTION REGISTER RS = 1 : DATA REGISTER
5	R/W	READ/WRITE SELECTION	R/W = 0 : REGISTER WRITE R/W = 1 : REGISTER READ
6	E	ENABLE SIGNAL	
7	DB0	DATA INPUT/OUTPUT LINES	8 BIT: DB0-DB7
8	DB1		
9	DB2		
10	DB3		
11	DB4		
12	DB5		
13	DB6		
14	DB7		
15	LED+	SUPPLY VOLTAGE FOR LED+	+5V
16	LED-	SUPPLY VOLTAGE FOR LED-	0V

Table 2.1: PIN Configuration of LCD [7]

2.3 SIM300

SIM300 is a Tri-band GSM/GPRS engine whose working frequencies are EGSM 900 MHz, DCS 1800 MHz and PCS1900 MHz. SIM300 provides GPRS multi-slot class 10 capability and support the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4.

This GSM Modem is compatible with any GSM network operator SIM card and behaves just like a mobile phone with its own unique phone number. Applications like SMS Control, remote control and data transfer can be developed easily using SIM300.[9]

The physical interface to the mobile application is made through a 60 pins board-to-board connector that provides all hardware interfaces between the GSM and customer's boards.[13]

- The keypad and SPI LCD interface will give you the flexibility to develop customized applications.

- Two serial ports can help you easily develop your applications.

- Two audio channels ie two microphones inputs and two speaker outputs are present. This can be easily accessed by AT command.

2.3.1 Features of SIM300

- Single supply voltage of 3.4V – 4.5V.
- Typical power consumption in SLEEP mode to 2.5mA
- SIM300 works in Tri-band: EGSM 900, DCS 1800, PCS 1900 .
- Normal operation in temperature range of -20°C to +55°C
- Stores SMS in SIM card
- External Antenna is connected via 50 Ohm antenna connector or antenna pad.
- It has two serial interfaces.
- Timer function is programmable via AT commands.

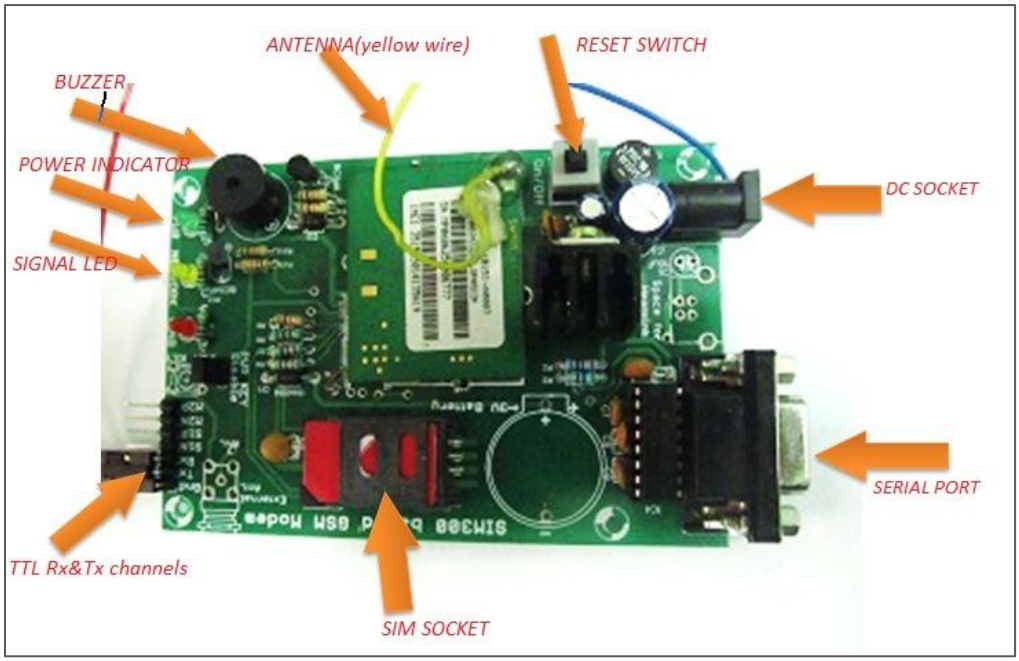

Fig 2.6: overview of SIM300

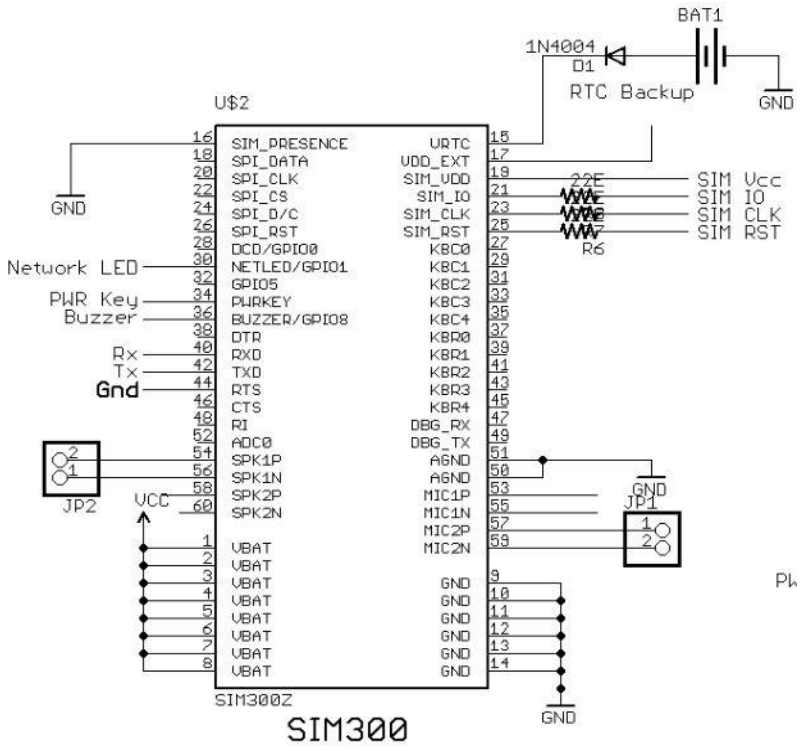

Fig 2.7 :Block diagram & pin configuration of SIM300

2.4 ATmega32

The Atmel AVR ATmega32 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, ATmega32 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed [4]. ATMEGA 32 Development Board is made from double sided PTH PCB board to provide extra strength to the connector joints. Power supply for the board ranges from 7 to 15V DC . It has built-in reverse polarity protection. It also has 7805voltage regulator. The heat sink dissipates the heat so that it can supply 1Amp current continuously without being over heated. It has switches for reset and power. All the ports are connected to standard 10 pin FRC pins.

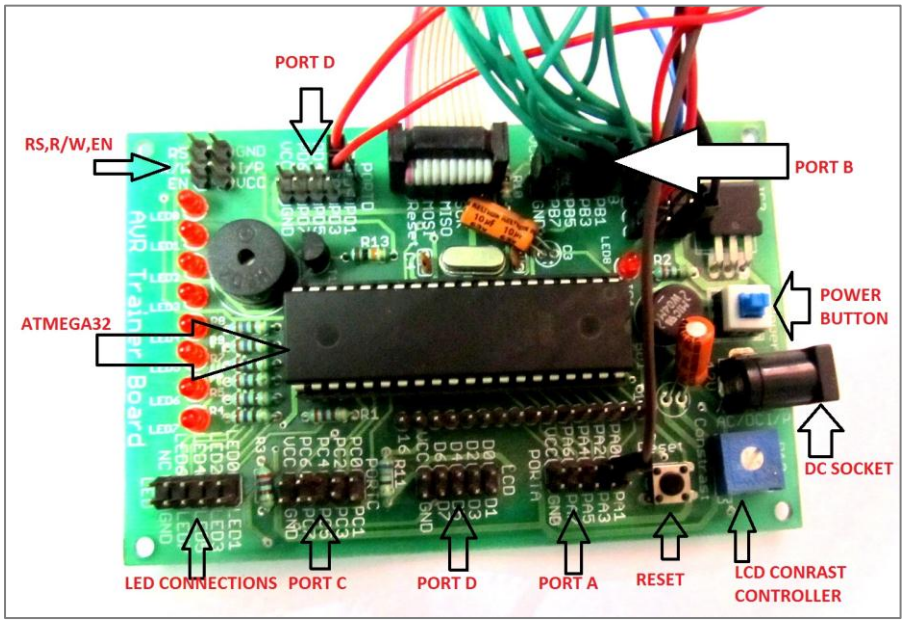

Figure 2.8: AVR Development Board

2.4.1 Features of AVR Microcontrollers (ATMEGA-32)

- 32K bytes of ISP Flash Program memory with Read-While-Write capabilities.
- 1Kbyte EEPROM.
- A programmable Watchdog Timer with Internal Oscillator.
- 2K byte SRAM.
- 32 general purpose I/O lines.
- 32 general purpose working registers.
- A JTAG interface is available.
- On-chip debugging support and programming.
- Timer/Counters with compare modes.
- A serial programmable USART.
- A byte oriented Two-wire Serial Interface.
- An 8-channel, 10-bit ADC.
- An SPI serial port.
- 6 software selectable power saving modes [4]

2.4.2 Architecture and Pin Configuration of ATmega32

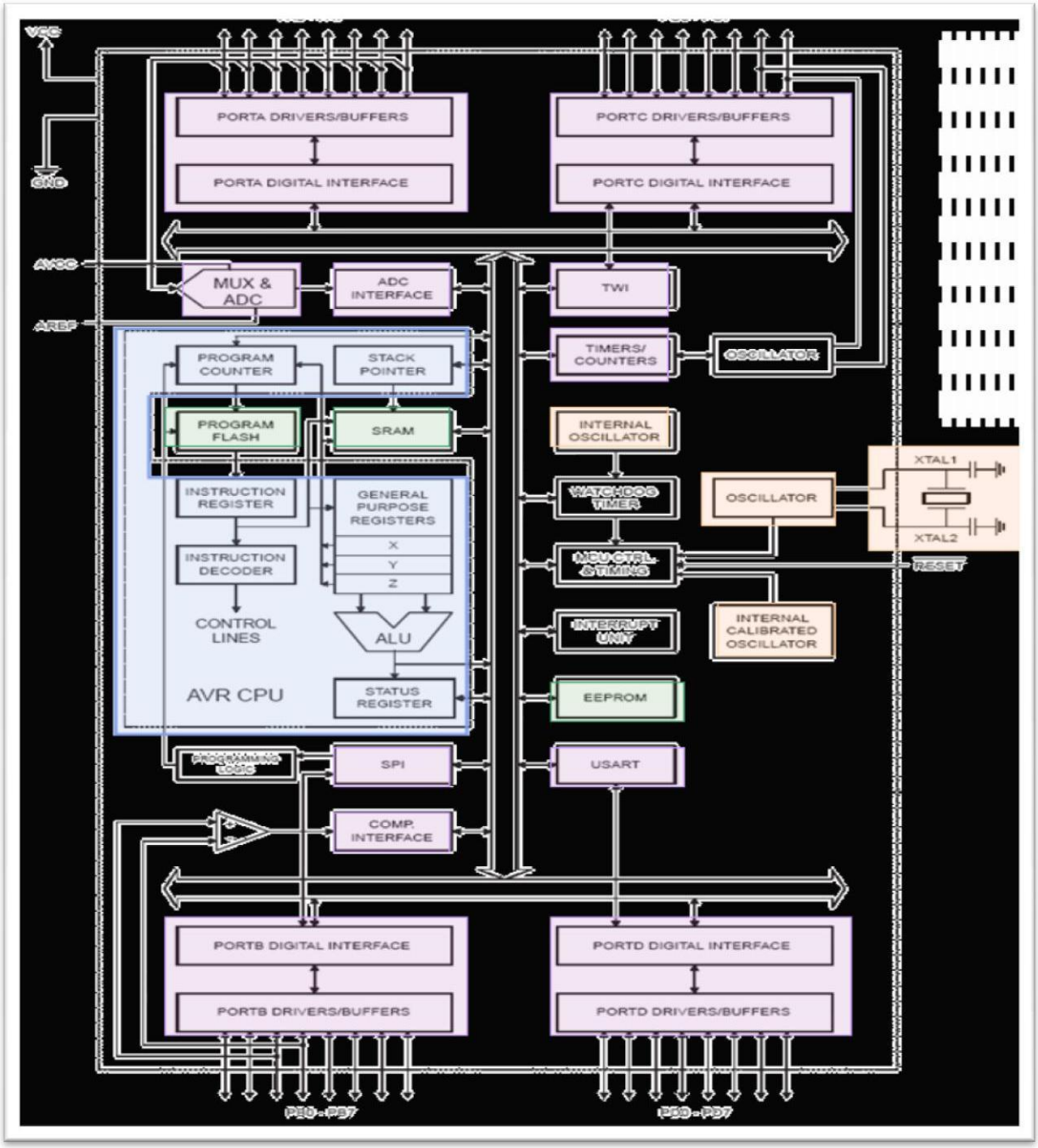

Figure 2.9 Architecture of ATMEGA 32

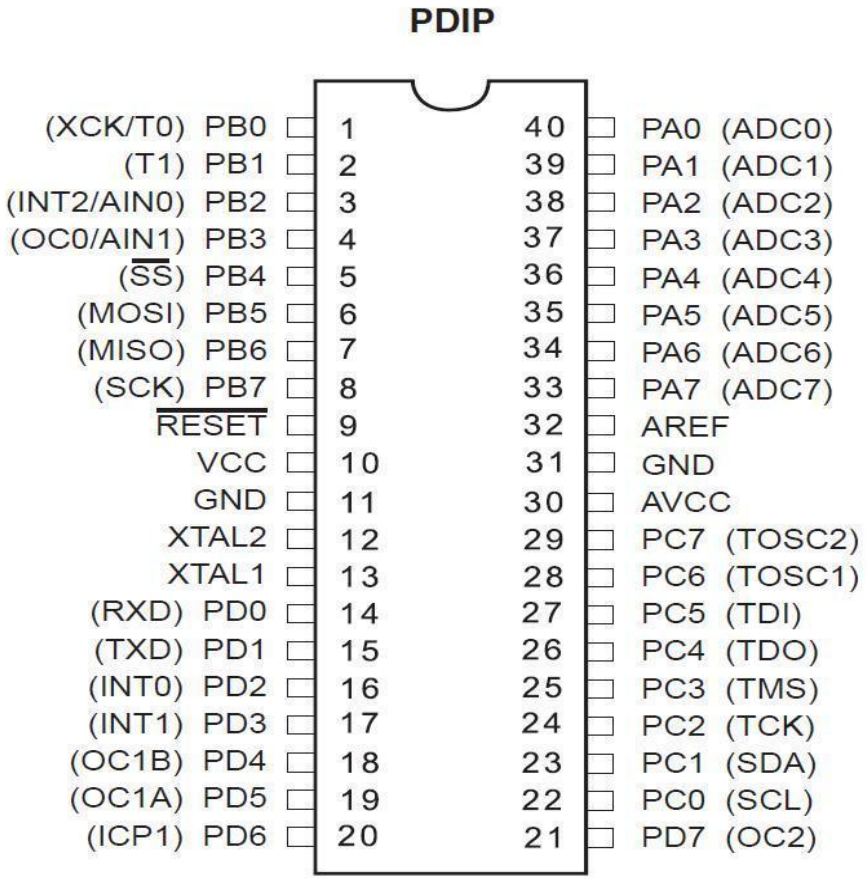

Figure 2.10 Pin configuration

2.5 Software Module

The program is written in Embedded C in AVR Studio 4. AVR Studio is an Integrated Development Environment (IDE) to write and debug AVR applications in Windows based operating systems; ex windows 8. AVR Studio provides a project management tool, simulator,assembler and source file editor for C/C++, emulation, programming and on-chip debugging .The project in AVR Studio is created under AVR GCC type. The AVR GCC plug-in is a GUI front-end to GNU make and avr-gcc. The build and run tool is WINAVR tool is used to convert C Language to HEX File. The HEX file is dumped into the ATmega32 microcontroller using SinaProg 1.3.5.6. [6]

Chapter 3

System Design

3.1 System model

Our wireless weather monitoring System is an automated version of manually measuring temperature and sending the information to a distant database wirelessly via sms. Our system has got almost all things automated so that we get an advantage of this concept ie the real time direct measurement of the parameters (here temperature) through GSM. Maintaining backup of sent data is easy and can be done within a few seconds. This model uses a LM35, GSM module (SIM300), LCD JHD 162A and a ATMEGA-32 microcontroller (AVR trainer Board). The GSM module is connected to PC/Notebook through RS232 cable .Windows has a built in serial monitoring software called Hyperterminal to read the messages sent by modem. The system model is shown in Figure 3.1 which says about the connectivity of all mentioned devices. The LCD used in this project can be detached when we use the design for commercial purpose. LCD is attached to ATMEGA32 to simultaneously display the measured temperature, through which we can experimentally check whether the data that is being sent is correct [1].

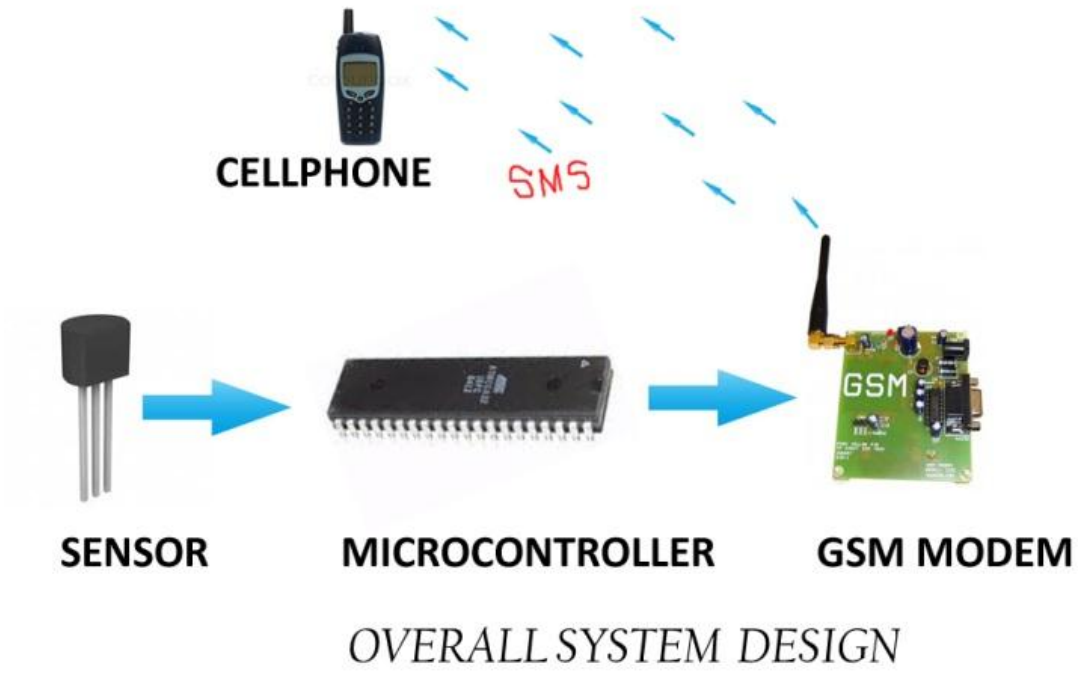

Figure 3.1 : System Model

3.2 Working of system model

The LM 35 is the temperature sensor connected to PA0 port of the ATMEGA32 microcontroller device. The output voltage sensor is obtained in millivolts and is converted to digital value. The GSM modem and LCD are connected to microcontroller. The temperature can be monitored directly which is simultaneously displayed on the LCD and a message is sent to the mobile by using GSM technique at the same instance.

3.2.1 Overall functioning

- Analog output from the LM35 is fed to Atmega32 at pin number 40 [11]
- Initialize the ADC and the converted value is stored in ADCH.
- JHD 162A LCD is interfaced with microcontroller at PORTB to display the output temperature.
- LCD is connected in 4 bit mode, it requires 4 data pins (DB4…DB7, only the upper nibble) and 3 control pins (RS, R/W, EN).
- SIM300 is connected through TTL interface with microcontroller, it requires 2 data pins(PD0-Tx & PD1-Rx)
- AT commands are used to send and receive SMS[2].

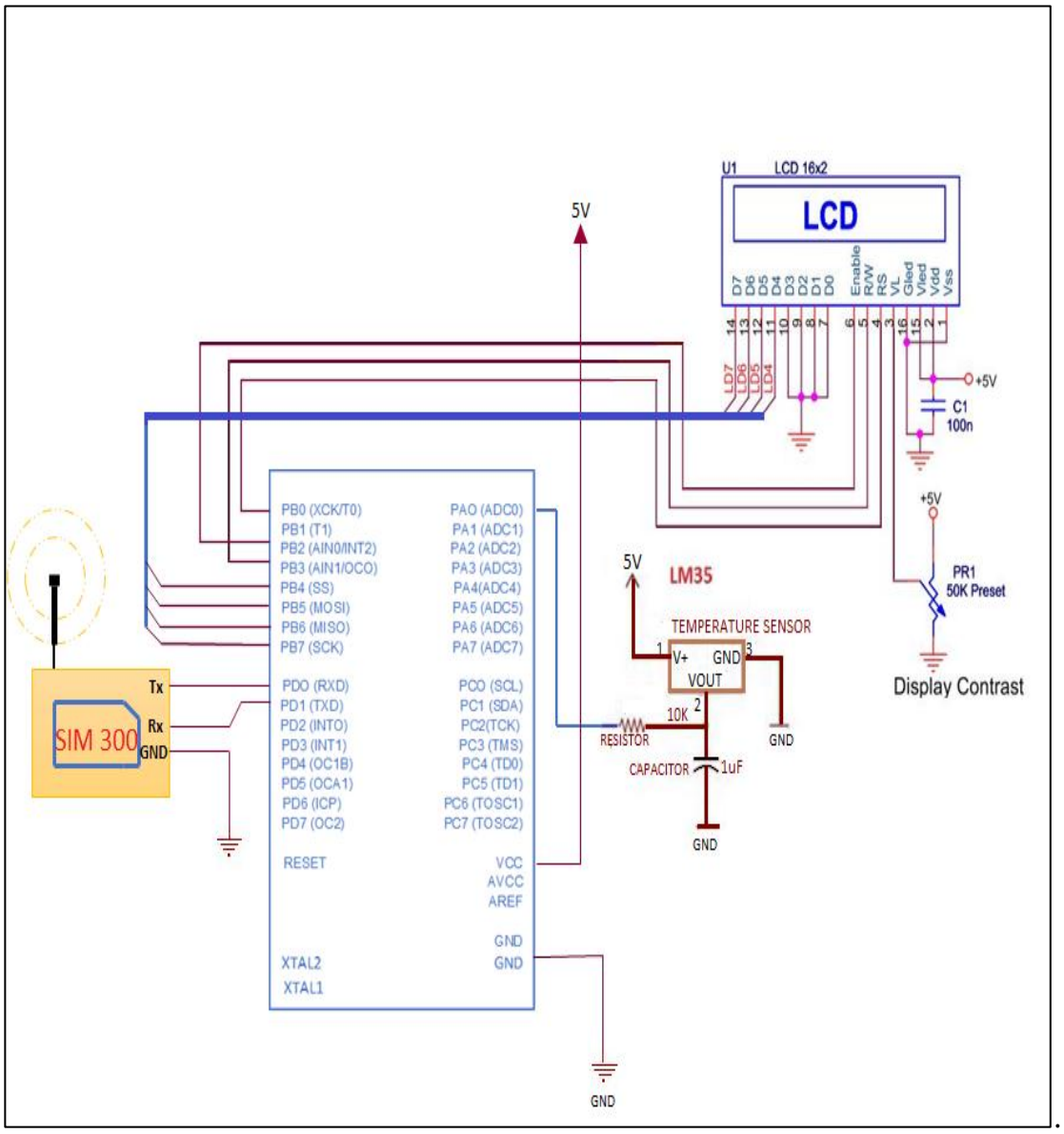

Fig 3.2 :Total interfacing and circuit diagram

3.2.2Detailed Working

3.2.2.1 LM35 interfacing with AVR Board

LM35	AVR BOARD
Vcc	Vcc(5volts)
Output	Port A(Pin Pa0)
Gnd	Gnd

Table 3.1

3.2.2.2 Algorithm for ADC conversion with flowchart

- The output of LM35 linearly varies with temperature.
- The output is in 10MilliVolts per degree centigrade.
- The ADC gives an output in the range of 0-1023 value.
- Each step is of size 5MilliVolts.
- If ADC value is X then analog voltage value is X*5mVolts.
- Final TEMPERATURE=(X*5)/10 degree centigrade.

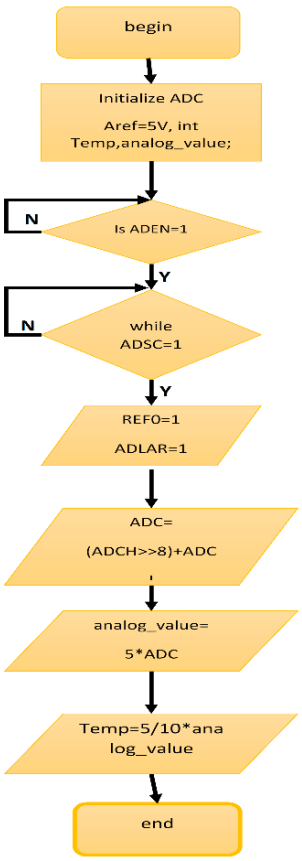

Figure 3.3: Flowchart for adc conversion

3.2.2.3 LCD interfacing with AVR Board

LCD(JHD 162A)	AVR BOARD(PORT B)
Pin Number 1	GND
Pin Number 2	VCC(5V)
Pin Number 3	GND
Pin Number 4	PB0
Pin Number 5	PB1
Pin Number 6	PB2
Pin Number 7	Left Open
Pin Number 8	Left Open
Pin Number 9	Left Open
Pin Number 10	Left Open
Pin Number 11	PB4
Pin Number 12	PB5
Pin Number 13	PB6
Pin Number 14	PB7
Pin Number 15	VCC
Pin Number 16	GND

Table 3.2

3.2.2.4 Writing commands in LCD in 4 bit mode

- LCDs have both 4-bit and 8-bit mode[7].
- First command should be sent in 8-bit mode, after that it should send a command to the LCD to operate in 4-bit mode.
- Since pin 7-10 are connected to ground on the LCD panel, we must use the 4-bit communication mode.
- The LCD defaults to 8-bit mode.
- Function set DL — specifies the interface data length
    - 0-4 bit mode
    - 1-8 bit mode

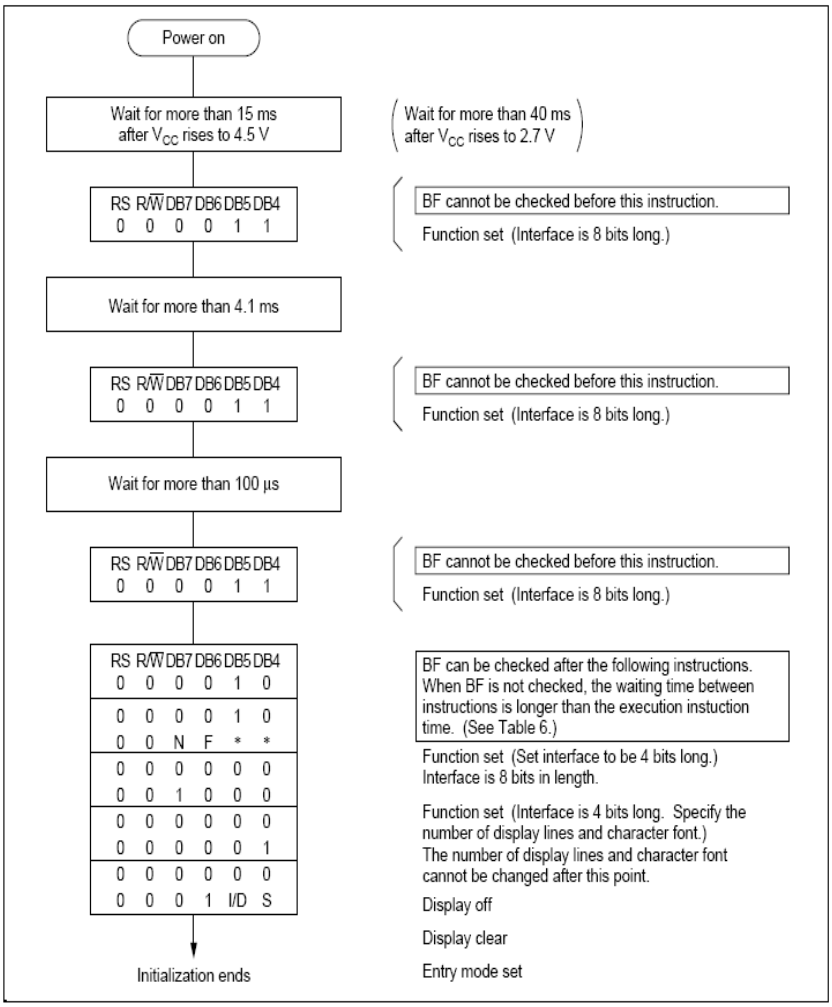

Figure 3.4: LCD 4 bit interface

3.2.2.5 SIM300 interface with AVR Board

SIM300	AVR BOARD
Vcc	Vcc(12Volt)
Gnd	Gnd
Tx	PD0(PORT D)
Rx	PD1(PORT D)

Table 3.3

3.2.2.6 Algorithm for checking the sim300 using PC

- Insert a SIM card on the board into the SIM tray.
- Attach the board to the computer's USB port using a RS232 to USB serial cable.
- To read the text being sent by the modem windows has a built in serial monitoring software called Hyperterminal. Find it at Start ->> Programs - >>Accessories ->> Communications - > >Hyperterminal
- Enter connection name.
- Select the serial port at which the modem is connected under the "Connect Using" option.
- Select Baud rate 9600(default) and Flow control none. The GSM module works on a serial communication as well as TTL interface that can work within a range of speeds from 1200 bps to 1152000 bps.
- Enter "AT" in the Hyperterminal, the board will respond "OK" if all the things are connected correctly.
- The yellow LED is used to display the network status.
- LED Off means SIM300 is not receiving signal.
- 64ms to 0.8 Sec Off means SIM300 is having weak or no network.
- 64ms to 3 Sec Off means SIM300 found network .

3.2.2.7 Flowchart for auto sending of SMS

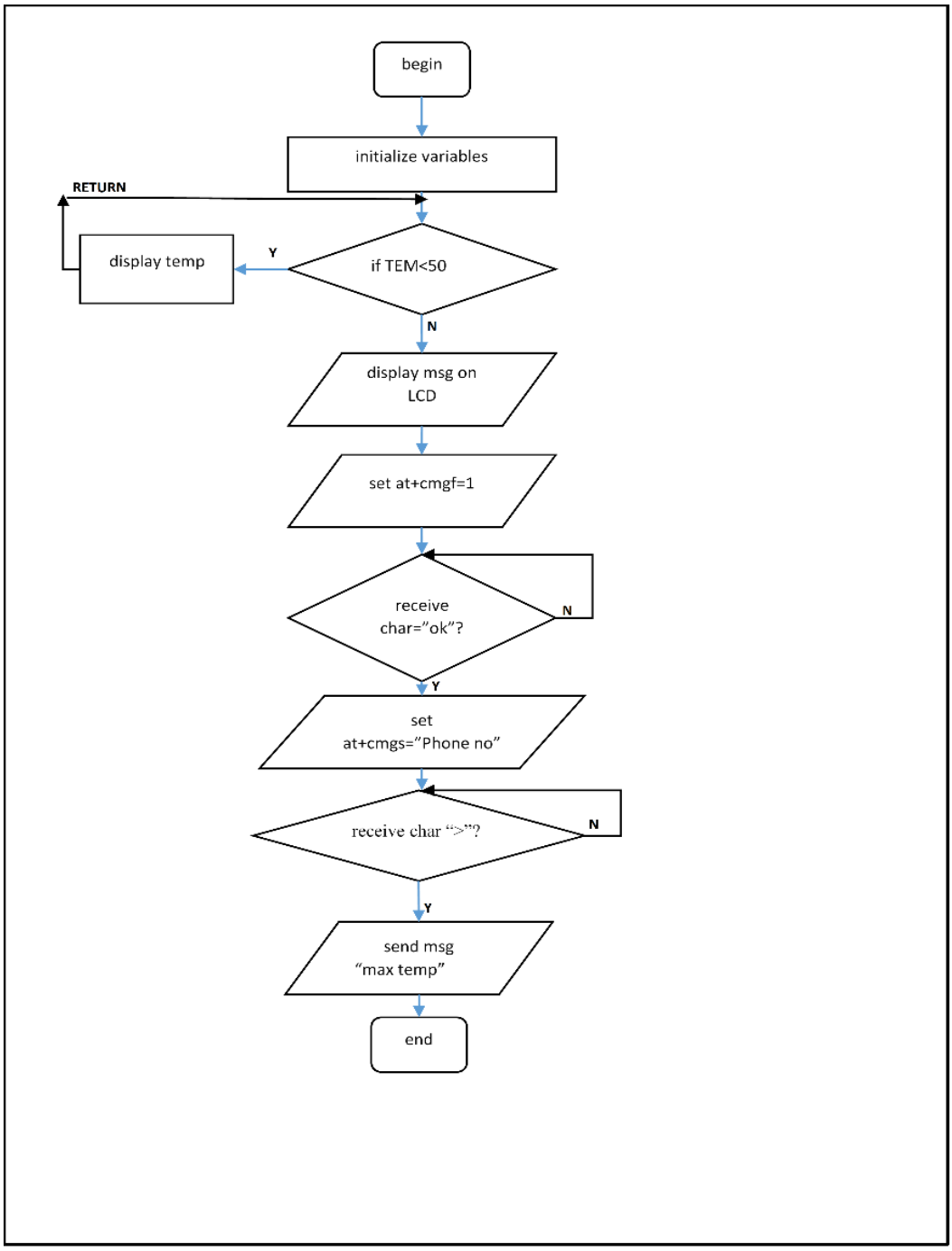

Fig. 3.5 Flowchart for sending Message

Chapter 4
Result and Discussion

4.1 RESULT and DISCUSSION

LM35 senses the temperature and the data is sent to MCU. Crystal-oscillator generates frequency of 11.0952MHz used for operation, the data is stored in EPROM chip which is simultaneously displayed on LCD. Microcontroller stores the digital data after converting the analog data from sensor unit through ADC, for some delay unit of time(here 200ms) and resets the reading in MCU as well as in LCD.

We program the MCU and manipulate ADSCRA register to enable ADC feature. ADEN, ADSC, ADATE bits are set to 1 such that the MCU continuously takes input and convert it into digital data. The data is stored in ADCH and ADCL registers from which we mathematically calculate temperature in degree centigrade and display it in LCD.

The device is programed to display data on LCD continuously .once the temperature goes above 50 °C, An alert message is displayed “max temp” on LCD. At the same time it sends a message to the programmed number which reads “max temp reached”. The microcontroller continuously keeps on monitoring the voltage level at Lm35 output. Once it again goes below 50°C the MCU displays a message on LCD which reads “temp now stable” and at the same time it sends notification in the mobile saying “temperature now stable”.

Below is the list of figures in which LCD displays the output as per changing temperature :

1. Condition (temp<50)

Fig 4.1: The temperature is continuously being displayed till it is below 50 degree.

2. Condition (temp>50)

Fig 4.2: When the temp exceeds 50 degree it displays an alert message that “maximum temperature is reached”.

Before sending SMS the LCD displays the message as in figure 4.3 below.

.

Fig 4.3

After the SMS is successfully sent the LCD displays the following message as displayed below.

Fig 4.4

3. Condition (temp<50)

When the temperature once again falls back below 50°C the following message is displayed as shown below

Fig 4.5

Wireless weather monitoring system is a microcontroller based project and can be implemented practically as displayed. In this project the temperature sensor (LM 35) is connected to ATMEGA32 microcontroller and temperature result is sent to GSM modem which is simultaneously displayed on LCD. Based upon the experimentation and implementation, we came to observe that the temperature can be monitored in an isolated place using LM35 (temperature sensors) and can be sent via SMS to a distant users mobile.

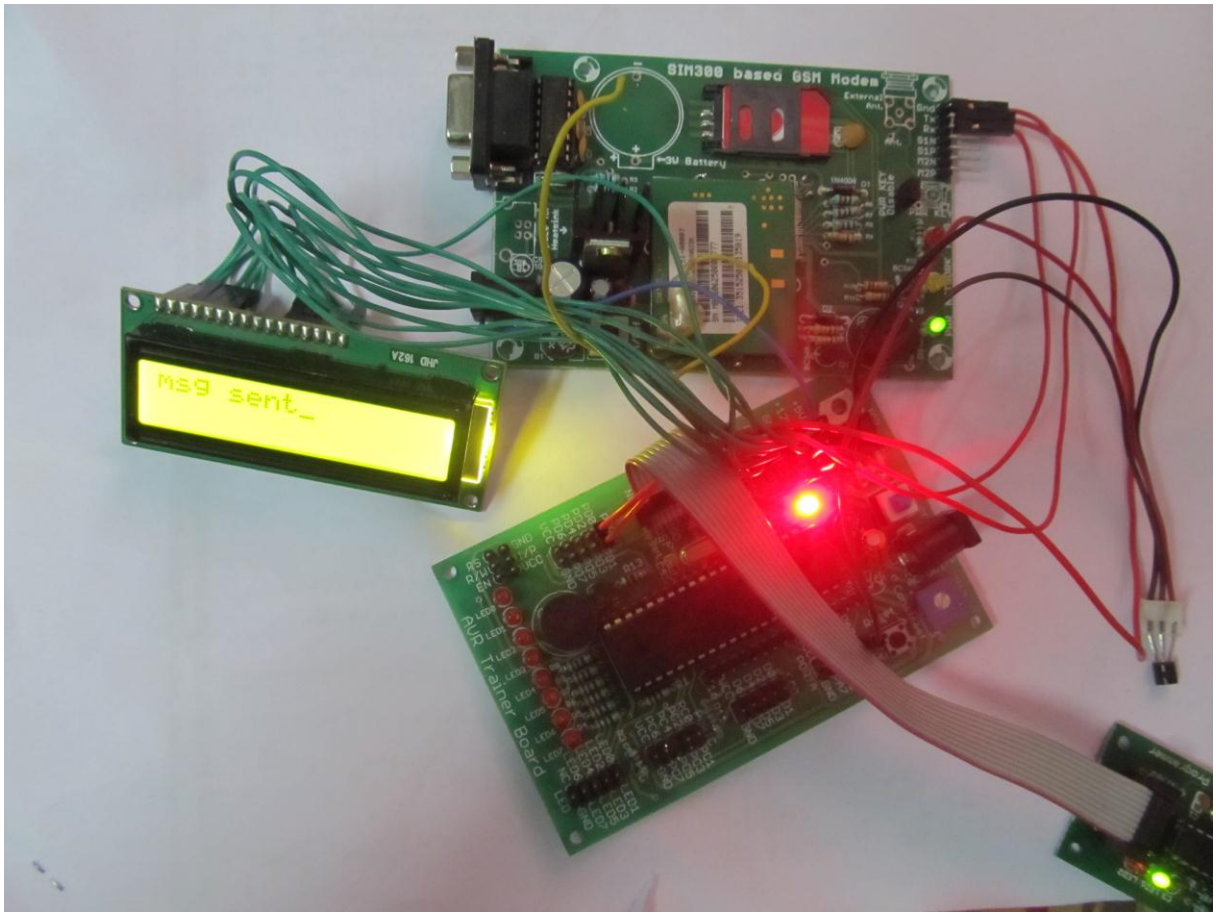

Fig 4.6 Working model of Wireless Weather Monitoring System

Chapter 5
Conclusion and Future Scope

Conclusion

The project deals with designing a simple and low cost weather monitoring system using LM35, LCD, SIM300 and ATMEGA-32 microcontroller unit to monitor weather conditions of the desired location and transmit it to a a cell phone at distant location through SMS. The designed product module is at prelim stage and designed only for temperature monitoring but can be enhanced for monitoring other different type of environmental and climatic behavior of a location, which also can be cost effective.

Future Scope

- Different other sensors as humidity sensor, light intensity sensor, pressure sensor can also be interfaced with the microcontroller to fetch various information about a location.

- Automatic irrigation control can also be implemented using moisture sensor to fetch data regarding water presence in the farm and do turn on or turn off water pump accordingly.

- Trespassing can be monitored developing surveillance system using infrared sensors and pressure sensors.

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